GALLEY HEAD LIGHTHOUSE.

RETURN to an Order of the Honourable The House of Commons, dated 15 August 1879;—*for*,

COPY "of REPORT to the Commissioners of Irish Lights, by Professor *Tyndall*, F.R.S., of an Inspection of GALLEY HEAD LIGHTHOUSE on the 9th day of May 1879; together with OBSERVATIONS on that REPORT by the Inspector of Lights and the Engineer to the Irish Lighthouse Board."

Board of Trade, 15 August 1879.

T. H. FARRER.

— No. 1. —

REPORT of Professor *Tyndall*, F.R.S.

9 May 1879.

Sir,

In compliance with the desire of the Commissioners of Irish Lights that I should visit and report upon the new lighthouse at Galley Head, I quitted London on the morning of 8th May, joined the "Princess Alexandra" at Milford in the evening, and reached Galley Head on the following day.

At my request, the Commissioners were good enough to invite Captain Cole, their chief inspector; Mr. William Douglass, their engineer; Captain Galwey, Commander of the Princess Alexandra; and Mr. Wigham, inventor of the system of illumination special to Galley Head, to be present during the observations.

I examined in the first place the quadriform dioptric apparatus employed for the concentration, direction, and multiplication of the light. I was also present during the rehearsal of the experiments to be subsequently made afloat. The glass of the apparatus seemed singularly free from striæ and other mechanical defects. Looked at normally, moreover, it appeared very transparent; but on looking at it obliquely, so as to cause the light reaching the eye to traverse considerable thicknesses of the glass, the colour was of a decided green. The influence of this colour may be of small practical moment; but, so far as it is operative, its action is to withdraw from the beam a fraction of the particular rays which are most effectual in penetrating a hazy or foggy atmosphere.

The light at Galley Head has been named by Mr. Wigham "the group-flashing light," the flashes being produced by a method perfectly novel in lighthouse illumination. The occultation of a fixed light, as first illustrated by Mr. Babbage, may be effected by causing opaque screens to close at certain intervals automatically round the light; or the occultation may be produced, as at Wicklow Head, by the lowering at given intervals of a gas flame. The arrangement at Galley Head is totally different from either of these. Here a flame of a certain width, determined by experiments made at Rockahill, and described in my report to the Board of Trade of 18th September 1871,* sends forth a beam of such divergence as to cause it to occupy fifteen seconds in passing over the eye of the mariner. But instead of allowing it to pass continuously, as in the ordinary revolving light, a simple automatic apparatus cuts up this broad beam into a series of flashes, sufficient in number to ensure that they can never wholly escape the attention of the mariner, and in each of which a flame of great power is brought into play.

A burner

* *See* Papers presented to Parliament by Command in 1875. [C. 1151.]

A burner of 68 jets was found on the occasion above referred to admirably suited to these ends. In ordinary weather a single burner of this description, placed, as in a revolving light, at the common focus of eight annular lenses, is employed at Galley Head. Four tiers of such lenses are erected, one above the other, each tier possessing its own burner. Hence the name of the apparatus. As the weather thickens, these burners are ignited in succession, the power of the light, if the adjustments be correct, being sensibly doubled, trebled, and quadrupled, when the biform, triform, and quadriform arrangements are respectively brought into play.

At the usual sunset hour, the single 68-jet burner was ignited, and it continued burning up to 8.50 p.m., when the experiments began. We were then equidistant from Galley Head and the Old Head of Kinsale, being 12½ miles from both. The night was a dark one, neither moon nor stars being visible; but though the upper atmosphere was filled with heavy clouds, the lower air was clear. Commencing with a power of 12 burners, we ascended through successive stages to a power of 108 burners, then fell to a power of 28 burners—the automatic flashing of the light being continued throughout this entire series of experiments. The 12-jet burner yielded two bright flashes, the 28-jet burner three brilliant flashes, the 48-jet burner four strong flashes, the 68-jet burner five powerful flashes, while the 108-jet burner produced seven flashes of still greater intensity. The flashes here enumerated were, in each particular case, of sensibly the same strength; but besides these gushes of full power, each series was heralded and ended by a flash of minor intensity. With the larger burners, moreover, when the observer was placed in the angular space between two successive beams, a residual speck of light was observed winking in synchronism with the rise and fall of the flame within the apparatus. No mariner could, in my opinion, be in the least degree embarrassed by the effect here described.

Indeed, this intermittent speck enabled us clearly to realize one of the principal advantages of the Galley Head Light. The speck accurately represented the aspect of a fixed light when enfeebled by distance or thickish weather. A great number of fishing boats were afloat on the night of the 9th, and had the speck been fixed, it could not have been distinguished from the lights of the boats. It would have formed one of a multitude of luminous points of approximately equal intensity. But winking as it did, it immediately differentiated itself from its fellows, a confounding of the shore light with the ship's lights being thereby rendered impossible.

In the next series of experiments (time 9.25), the apparatus was employed as an ordinary revolving light, the flashing being suspended; and instead of the beam from a single burner, the quadriform light was exhibited. The beam from the four 28-jet burners, which was strong, brilliant, and altogether satisfactory, required six seconds to pass over the observer's eye. The beam from the four 68-jet burners, which yielded a light much superior in intensity to that of the 28-jet burners, had, as before stated, a duration of fifteen seconds. It is this widening of the beam outside of the apparatus as the diameter of the burner inside is increased, that enables the 68-jet beam to be cut up into the five powerful flashes and the two minor flashes already alluded to.

The augumented intensity of the beam from the larger burner is to be ascribed to the increased number of luminous layers from which the radiation comes. Supposing the radiation through any lens to emanate from a line of burners one deep, and parallel to the lens, the effect of augmenting the length of this line would simply be to increase the width of the beam outside the apparatus. There would be no increase of intensity. But if contemporaneously with the lengthening of the row of flames, other rows were placed before and behind it, it is obvious that not the width of the beam only, but its intensity also, would be increased. This is what virtually occurs when the larger burners are brought into action at Galley Head.

Wishing to test still further the increase of intensity as the number of jets were augmented, arrangements had been made for stopping the apparatus, and sending the beam for a time in a fixed direction. During this interval, it was proposed to run through the series of powers, from the 28 to the 108-jet burner. The tide, however, had so far drifted us from the axis of the beam, that before we recovered it the two first experiments were practically defeated. The opportunity of comparing the largest and smallest burners, which was my principal

principal object in making the arrangement, did not therefore present itself. Evidence as to the augmentation of intensity with the augmentating magnitude of the burner was, however, furnished by the preceding experiments. On this point there was no difference of opinion. Mr. William Douglass, who stood at my side, pronounced the increase of light in passing from the 28 to the 68-jet burner to be considerable. My notes describe the fixed beam of the 68-jet burner as an extremely fine and steady light; while, in relation to the distance, the beam from the 108-jet burner is described as exceedingly powerful.

Recurring to the group-flashing (time 9.55), and beginning with the single burner of 68 jets, we passed to the biform, triform, and quadriform in succession. The beams, as might be expected, augmented in intensity as the number of burners increased, the flash from the quadriform being very powerful.

Rendering the beam again fixed, we steamed across it with the view of observing any variations in intensity which might exist at different parts of its transverse section. The observation, which was inferior in delicacy to that of the flashes, corroborated the conclusion drawn from the latter, that the body of the beam is of nearly the same intensity throughout, the fall to obscurity at its edges being rapid.

Returning to the single 68-jet flashing light, we steamed out until it dipped beneath the horizon. In the cloudy air above the lighthouse every pulse of the flame was distinctly visible, after the direct beam had disappeared. I cannot but think that these atmospheric thrills will prove of great importance to the mariner, even in atmospheres thick enough to render the light itself invisible.

At 15 minutes past midnight, the 68-jet quadriform was again brought into action, we being then 21 miles from Galley Head. On the bridge of the steamer the atmospheric pulses only were visible; but ascending to the top of the deck-house, the light itself came into view, its white blaze striking the eye as if the lighthouse were close at hand. On ascending from the bridge, the sudden emergence of these powerful flashes out of the darkness of a starless and moonless night was in the highest degree impressive.

My impression at the time was that, on the whole, I had never seen a finer light. Wishing, however, to check my own judgment by that of an independent and experienced observer, at the conclusion of the experiments I asked Mr. Douglass whether he knew of any light which, in point of power and distinctiveness combined, came up to that of Galley Head. His reply was that he knew of none.

The programme of the night's experiments was carried out with accuracy and promptitude by Mr. Young, with the assistance of the light-keepers. I append the programme which summarises the night's observations.

Testimonies regarding the Galley Head Light.—From a report presented to the Board of Trade on the 18th September 1871,* I quote the following brief paragraph: "Should it be thought desirable to give a revolving light so distinctive a character as to render it perfectly unmistakable, the 'group-flashing gas-light,' as its inventor, Mr. Wigham, calls it, secures this end. I have not been called upon to offer any recommendation as to its adoption, and I would, therefore, merely refer to it as a light of unrivalled individuality, of great power, and, in Ireland at least, of moderate cost." Appended to this paragraph is the following foot-note: "It might be tried in the next new lighthouse, and thus tested without any disturbance of existing lights."

The light at Galley Head, which was started at the beginning of last year, is the outcome of this suggestion; and I have now to adduce additional evidence in justification of my recommendation to the Board of Trade, that the group-flashing light should have a full and fair trial upon the coast of Ireland.

During my experiments at Rockabill, in September 1871, I was honoured by the company of Sir Leopold M'Clintock, who, in a letter addressed to Mr. Wigham, on the 18th September 1871, thus expresses himself: "No better means could be devised for distinguishing a light from other lights than this plan of a group of flashes. The half-minute interval between the groups is quite

* *See* Papers presented to Parliament by Command in 1875. [C. 1151.]

quite sufficient, and yet not greater than can easily he estimated by tbe observer, without having recourse to a watch to measure the time; and the periods recurring within 45 seconds, that short time is sufficient to determine whicb ligbt it is; and both these are great practical advantages. I consider that the superior brilliancy of gas to oil, and its applicability both to revolving and fixed ligbts, is most satisfactorily established; and as I regard tbe proposed change solely from the seaman's point of view, I look exclusively to tbe relative efficiency, without any regard whatever to their comparative cost."

In September 1874, the preliminary experimental arrangements, devised at Howth Baily to illustrate tbe construction and the power of the triform light, was inspected by Sir William Thomson. From a letter addressed to Mr. Wigham on the 12th October 1874, I make the following extract:—"I bave much pleasure in reporting upon the experiments on the Howth Baily Lighthouse arrangements, wbich I witnessed from Salthill on the evening of the 21st September, and from my yacbt on tbe evening of the 22nd September.

"1st. The great fog-power of 108-jet burners showed an immense superiority of light over the ordinary light of the lighthouse. The quick transition from the ordinary ligbt to the higb power was very remarkable, and seemed most satisfactory. Next day I was very much pleased to see, at the lighthouse itself, the simple and thoroughly trustworthy apparatus by wbich this transition was made.

"2nd. The triform ligbt exhibited from the lower position, in the neighbourhood of the chief tower, was strikingly superior even to the great fog-power of 108 burners exbibited on the cbief tower; so much so that a heavy thunderstorm, whicb happily chanced to pass during our experiments between the Salthill Hotel and the lighthouse, completely eclipsed tbe ligbt of the chief tower, wbile the triform still sbone conspicuously through it."

The two weighty authorities here cited based their conclusions upon experiments made with apparatus temporarily erected at Howth Baily and Rockabill. I have now to refer to tbe testimony of seamen with regard to the merits of the ligbt permanently established at Galley Head. Before me are various testimonials from commanders on the Inman, Wbite Star, and Cunard lines of steamers, all of whicb speak highly of the light. Captain Fulton considers it "one of the best in the Channel, being botb clear and unmistakable." The testimony of Captain Watkins, wbo observed the light from a distance of 20 miles, is to the same effect. Captain Leitch describes it as "tbe most marked and unmistakahle light" he ever saw. Captain Laud calls it "a splendid light, easily distinguisbed by its marked cbaracter." Captain Brooks, who had an opportunity of viewing the light in very hazy weather, pronouuces it "a most excellent light, whicb can bc easily distinguished from every other ligbt on tbe coast." Captain Kennedy considers it "one of the best and most powerful ligbts in the Channel." Captain Gleadell affirms it to be "a most powerful, strongly-marked, and appropriate light, and of great service to shipping navigating that part of the Irish coast, it being so readily distinguished from any other in its vicinity." Captain M'Mickan, who observed the light at distances varying from three to 18 miles in showery weatber, states tbat it could not possibly be mistaken for any other light wbicb he had ever seen. He considers it a very great advantage that the light can be increased in thick weather, and finally describes it as "one of the most important, useful, and brilliant lights in St. George's Channel."

To the foregoing strong testimonials I would venture to add those of Mr. Gray, Secretary to the Marine Department, Board of Trade, and of Mr. Hamilton, Accountant General of the Navy, whose ohservations are specially importaut, hecause tbey refer to the performance of tbe ligbt in foggy weather. Under date of 30th August 1878, Mr. Gray writes as follows:—"On that occasion we made a special visit, and tbe night was very favourable for a test; tbat is to say, it was sufficiently tbick to render tbe ordinary ligbt invisible from the place wbere we were stationed; and I can, from my own observation, wbich was carefully and patiently made, assert with entire confidence that as one ligbt after another was added, the illuminating power was materially, and visibly, and markedly

markedly increased; and that the ordinary light still being invisible, the quadriform not only illuminated the fog, but actually became visible."

The testimony of Mr. Hamilton, given on the same date, is to the same effect:—"The night I saw the quadriform light tried against the ordinary light at Howth Baily was a very foggy one, and I distinctly remember how the power of the light to penetrate the fog was increased as the burners in each tier were lighted. I remember, also, that while the fog at times entirely obscured the ordinary light, the quadriform was distinctly visible."

Concluding Remarks.—No words of mine could add any force to the consensus of evidence here brought forward. And when we remember the calamities which have occurred even in the neighbourhood of lighthouses, through inability to see the light, it surely behoves us not to throw away the chance of mitigating such calamities by the employment of a light capable of behaving in thick weather in the manner described by Sir William Thomson, Mr. Gray, and Mr. Hamilton. I only know indeed of one circumstance which could legitimately interfere with the extension to other important points on the Irish coast of the system of gas illumination, and that is inordinate cost of production. Regarding this point ample data must be in existence, and the Board of Trade, which has hitherto shown a marked liberality towards Mr. Wigham, has here, I think, a right to demand the fullest and most distinct information. The necessary and unavoidable accompaniments of the use of gas ought obviously, when the expense of this illuminant is in question, to be carefully kept apart from unnecessary ones. And here I am tempted to offer a remark which may be considered to lie beyond the strict limits of the present report. The cost of the lighthouse at Galley Head and of its adjuncts must have been very considerable. The quantity of land inclosed is large, a corresponding length of wall being needed to inclose it. The buildings are erected in the most substantial fashion, a finish being given to the doors, windows, and copings which must have entailed considerable expense. I will not say that in the long run it may not prove a wise economy to have incurred this outlay. But, with the exception of the gas-house and its appurtenances, it is not an outlay necessarily connected with the mode of illumination at Galley Head. Were oil instead of gas the illuminant employed, the expense of the buildings might have been substantially the same.

In conclusion, I would observe that gas lends itself with admirable freedom to any change in its mode of application which it may be thought desirable to make. The suppression, for example, of the flashing apparatus at Galley Head, would convert that light into an ordinary revolving light, surpassing any other in the world. Indeed, were the power of the burner reduced to 48 jets instead of 68, the light, with its full strength invoked, would still transcend all other revolving lights. Even the 28-jet burner would furnish a beautiful light. But the advantage of the present mode of illumination consists partly in the intensity and partly in the duration of the 68-jet beam, whereby the flashes are rendered so numerous and so powerful as to confer upon the light the individuality universally ascribed to it. I need not dwell upon the obvious fact that, broken into flashes, the 68-jet beam involves the expenditure of little more than half the amount of gas which would be required to feed it if used as a continuous light. It may be added that the 48-jet burner, with its four flashes, or the 28-jet burner, with its three flashes, would constitute a highly distinctive light; but I should deprecate the economy which would reduce either in number or power the flashes now sent forth from Galley Head.

I have, &c.
(signed) *John Tyndall.*

William Lees, Esq.,
Secretary Commissioners of Irish Lights.

APPENDIX to No. 1.

PROGRAMME.

Number of Experiments.	Time.	Character of Lights.	Number of Jets.	Number of Lenses.	Position of "Princess Alexandra."
	p.m. 8.40	Group-flashing - -	68	1	12½ miles off half-way to Old Head, Kinsale.
1	0.50	- ditto - - -	12	1	- ditto - ditto.
2	9. 0	- ditto - - -	28	1	- ditto - ditto.
3	9. 5	- ditto - - -	48	1	- ditto - ditto.
4	9.10	- ditto - - -	68	1	- ditto - ditto.
5	9.15	- ditto - - -	108	1	- ditto - ditto.
6	0.20	- ditto - - -	28	1	- ditto - ditto.
7	0.25	Revolving - - -	28	4	- ditto - ditto.
8	9.30	- ditto - - -	68	4	- ditto - ditto.
9	0.35	Fixed beam - -	28	1	- ditto - ditto.
10	9.40	- ditto - - -	48	1	- ditto - ditto.
11	9.45	- ditto - - -	68	1	- ditto - ditto.
12	9.50	- ditto - - -	108	1	- ditto - ditto.
13	9.55	Group-flashing - -	68	1	- ditto - ditto.
14	10. 0	- ditto (Biform)	88	2	- ditto - ditto.
15	10. 5	- ditto (Triform)	68	3	- ditto - ditto.
18	10.10	- ditto (Quadriform)	88	4	- ditto ditto.
17	10.15	Fixed beam - -	88	1	Steaming across beam.
18	10.30	Group-flashing - -	68		
19	12. 0	- ditto - - -	68		Horizon } About 21 miles
20	12.15	- ditto (Quadriform)	08		ditto } distant from
	12.30	- ditto - - -	68		ditto } Galley Head.

— No. 2. —

OBSERVATIONS of the INSPECTOR of LIGHTS.

Sir, Irish Lights Office, Dublin, 27 May 1879.

I HAVE the honour to inform you that, in obedience to the Board's order, I have carefully studied Professor Tyndall's report on his recent inspection of the gaslight at Galley Head, and must remark that I regret that report does not supply certain information which I consider the Board ought to possess before they at any time decide to adopt the same arrangement and system in any locality where it may in future be found necessary either to establish a new or change an existing one.

The night of the experiment was an exceptionally fine one, with clear atmosphere; the light was, therefore, seen under most favourable circumstances, which, whilst being advantageous in certain respects, did not afford an opportunity of showing the extent to which the maximum power of the light would be of use.

The ordinary single set of 68 burners produced a good light, there being but little difference between it and the one displayed from Kinsale Head; and I should suggest that an accurate comparison should be drawn between the expense incurred in producing those two lights.

Secondly, the increase in the light produced by advancing from one set of 68 burners to the quadruple form of the same, viz., 272, disposed in four tiers, did not appear to be at all proportional to the increased consumption of gas required to produce the light, which, whilst better perhaps than most of the lights existing in the United Kingdom, certainly could not in any way be considered to approach the electric light in intensity or illuminating power. The same was observable in increasing from 28 to 48 or 68 burners; and beyond the increased number of the flashes given during a revolution, it would have been

heen impossihle to estimate accurately the comparative power of the different lights.

Furthermore, when using the four sets of 68 burners, what I must consider a most serious defect presented itself, namely, a very strong reflection of the flashes taking place at a period when, properly speaking, there should have heen complete darkness; the intensity of these flashes quite equalled those produced when using 12 hurners only, and although possibly these might he totally inappreciahle in thick weather (but of which at present we have no proof), should such not he the case, the nature of the light, when using the quadruple force of 68, hecomes completely altered, and a stranger unaware of the peculiarities of the light could certainly never identify it hy the description laid down in sailing directions or the Admiralty list of lights.

Again, the difference in the numher of the flashes produced, when using different powers, tends also to destroy the character of the light, and renders it less distinctive than it should he. This defect is due entirely to an injudicious arrangement of the hurners, which for the minimum power required should he distributed round the circumference of a circle, capable of containing within its periphery all the burners required for the maximum power, viz., 68. Were this system adopted, as is the case in the Trinity House oil hurners, the number of flashes per revolution would be constant, increase in power heing ohtained by adding hurners internally instead of externally.

I have before noticed on the very small difference which exists hetween the lights at Kinsale Head and that at Galley Head, when using the ordinary 68-jet burner, and must draw the Board's attention to the fact that the fixed light at the former can he at once increased sixfold without any annual increase in the consumption of oil, or consequent expense, simply hy altering the power of the lenses.

I consider it highly advisahle that the relative expense between the uses of gas and paraffin oil as illuminating mediums should he carefully obtained for the information of the Board, and that a careful investigation should be made into the expenses incurred at present in the manufacture of gas, with a view to seeing how far they can be reduced helow 11 *s.* per 1,000 cuhic feet, which is about the present cost; and next year I propose to ask the Board for certain annual items connected with the manufacture of gas, to be tendered for as is usual in the supply of other stores, by which means a large economy will at once he effected.

Practical experience in the case of lighting towns hy gas and paraffin, shows that light for light the cost of the latter is three-fourths that of gas at 3 *s.* 8 *d.* per 1,000 cuhic feet; and assuming that the same relation exists when these illuminants are hurnt in larger volumes, as in lighthouses, gas must he produced for 5 *s.* 6 *d.* per 1,000 cuhic feet, and an intermittent light with equal periods of light and darkness used, to hring the expenditure hy the two systems to an equality, supposing in each case that maximum results are ohtained.

I heg to represent to the Board that I consider the estahlishment of the light at Galley Head to be one of those approaches which will hring us eventually to a knowledge of the scientific use of gas as an illuminant; hut in its present state, very far off perfection, on account of the want of individuality in the light when using different powers, a disproportional production of light when large volumes of gas are used, and extravagance in the manufacture of gas, all of which defects may he easily diminished, if not entirely ohviated, and that with an intermittent light gas may he used with greater facility, cleanliness, and economy than mineral oil.

I have, &c.
(signed) *Joshua Cole*, Com., R.N.,
Inspector.

The Secretary, Irish Lights Board.

— No. 3. —

OBSERVATIONS of the ENGINEER to the IRISH LIGHTHOUSE BOARD.

Irish Lights Office, Dublin,
Sir, 5 June 1879.

I HAVE the honour to report, for the information of the Board, that I have read Dr. Tyndall's report of the experiments observed from the "Princess Alexandra," on the 9th ultimo, and fully agree with him when he describes the Galley Head Light, burning the single 68-jet burner, as an extremely fine, steady light.

The first five observations consisted in observing the effect of an increase in the power of the single burner from 12 jets to 28 jets, from 28 to 48, from 48 to 68, and from 68 to 108 jets. At each change I noticed an increase in the power and brilliancy of the light, but not proportionate to the increased consumption of gas. This was partly due to the increased divergence of the beam of light from the large burners, and partly because a portion of the light from the large burner was not within the focus of the lens.

The 12 jet burner produced only two flashes, while the 108-jet burner produced seven; therefore, as the changing of the size of the burners changes the number of flashes in a light of the same character as Galley Head, and in ordinary revolving lights, tends more to lengthen the duration of the beam than add to its power, the quadriform or triform system appears to be the most suitable method of increasing the power of these lights in thick weather. With ordinary fixed lights, increasing the size of the burners to obtain greater power during fog is not so objectionable, excepting when a sharp cut of coloured light is required to mark a danger; then, as substituting a large burner for a small one would impair very much the sharpness of the cut, thereby tending to mislead the mariner, I would recommend the use of the triform system of three 28-jet burners—one to be used in clear weather, the others to be added during fog, as required.

The system adopted at Galley Head requires a large consumption of gas. During clear weather a 28 jet burner, especially in a revolving light, ought to give sufficient light for the mariner's requirements, and be visible at the horizon. At Galley Head the 68-jet burner is constantly used.

The residual or reflected flashes were seen distinctly at the long range of 21 miles. Although I am not prepared to state that the mariner would be likely to be misled by them, still they appear to me as a defect that mars the perfection of the light.

Dr. Tyndall, in quoting my testimony to the excellence of the light, has stated that which I fear may mislead the Board as to my real opinion respecting it. I understood Dr. Tyndall's question to refer only to its distinctive character, and I answered his question with reference to the character of the light, and not to its power. It is very difficult to compare the powers of lights, and decide accurately on their merits, unless they are seen at the same time; yet the impression remains on my mind, after careful observation of both lights from the sea, that the Lizard Lights are superior in penetrative power to Galley Head, and that the South Stack Light is equal to it when one 68-jet burner is used. Galley Head is, however, a light of very distinctive character, and ought not to be mistaken for any other light that I have seen..

I remain, &c.
(signed) *W. Douglass.*

William Lees, Esq.,
Secretary, Commissioners of Irish Lights.

GALLEY HEAD LIGHTHOUSE.

COPY of REPORT to the Commissioners of Irish Lights, by Professor *Tyndall*, F.R.S., of an Inspection of GALLEY HEAD LIGHTHOUSE on 9th day of May 1879, together with OBSERVATIONS on that REPORT by the Inspector of Lights and the Engineer to the Irish Lighthouse Board.

(*Mr J G Talbot*)

Ordered, by The House of Commons, *to be Printed*,
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Under 1 *oz*